

Editorial

Extra Corporeal Membrane Oxygenation (ECMO): The Machine We Love to Hate

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ECMO is an increasingly used tool in the arsenal of organ support. It still remains a challenge when to start ECMO therapy due to the variably amounts of patients' cardiovascular reserve. There are many delays to initiate ECMO that continue to haunt the clinicians: How invasive to get? Will organs recover? Will the patient tolerate transfer? Can the patient be anti-coagulated? Are we willing to relinquish control of case to other doctors? All these questions are important, but perseverating on them can delay possible intervention. All of the deliberation can be rounded into five very important considerations that should be considered before embarking on the ECMO pathway. This editorial will try to address each one of these issues.

1. Is my patient sick enough to get ECMO?
2. Will ECMO provide an opportunity to heal so my patient returns to a good quality of life?
3. Logistically can I do ECMO in my center or is the patient transferable to an ECMO site?
4. How and who manages patients on ECMO.
5. How do we stop ECMO once we start (for either better or worse).

There are conflicting reports of the benefits of ECMO, and unfortunately have resulted in ECMO being reserved for the sickest of patients [1,2]. It is very clear that the literature is confounded by selection bias, variable rescue therapies, and a need for well done, NIH sponsored studies [3]. Every study presents different patients, disease etiologies as well as various interpretations of the data [4]. Our clinical experience has been to consider ECMO early. Patients started on ECMO prior to vasopressor and multiorgan failure do better. But even without the vasopressor being considered, patients started on ECMO early did better which is supported by the literature. 2

The ability of the body to recover after severe organ injury, especially ARDS is impressive [5]. Using tools to predict survival have also been attempted but still not comprehensive enough to determine

survival with high sensitivity or specificity (poor ROC curve) [6]. Doing pre-hospitalization functional status has been helpful in case by case basis, but unfortunately there are no tools to help the clinicians. Our team excludes patients with chronic, illness that is not amenable to treatments such as advanced malignancy or nonreversible diseases like IPF if transplant is not an option. Reversibility is key. We have had numerous cardiac failures that have been supported by ECMO to recovery. The diagnosis of peripartum, viral, Takotsubo, post-operative, embolic, steroid, and even sepsis induced cardiomyopathy have been successfully treated with ECMO. Historically balloon-pumps were used to support these patients, but current literature is suggesting that balloon-pumps may be less effective than previous thought [7]. Although the literature is lagging behind the absolute indications, our institution has embraced the idea of a "trial of ECMO", in settings where acute organ failure occurs that is caused by reversible etiologies.

In the most recent, randomized control study on ECMO, Peck et al. showed that transfer of critically ill patients to a centralized ECMO site improves outcomes in ARDS patients [8]. The 2009, Australian/New Zealand H₁N₁ experience described by the JAMA paper, supports the idea that early intervention improves outcomes [9]. Although it is an extrapolation to apply improved outcomes in ARDS to respiratory failure from cardiovascular collapse, it is worth some pondering. There are many logistical issues involved in transporting respiratory cases which are acidotic and hypoxic, and planning in advance can minimize the delay and errors that are prone to happen. Although our group has shown that organ recovery can occur on ECMO, we attempt to initiate ECMO prior to multi-organ failure or lactic acidosis [10]. There are simple algorithms to facilitate transfer of these patients into tertiary ICU's, staffed by Intensivists with an interest and dedication to an ECMO service. The multidisciplinary team of cardiology, pulmonary and ECMO trained Intensivists works best to ensure a successful outcome.

Management strategies are defined by numerous societies around the world. Expert opinion focuses on three major issues [xi]. Reduce barotrauma, minimize a telectrauma, and avoid hyperinflation. These are very similar recommendations that stemmed from the pivotal ARDS net trial of 2000 [11]. Although the opinion is that minimizing lung strain is ideal, this cannot always be accomplished. Initiating ECMO is a multidisciplinary approach that clinicians, both pulmonary and surgeon must understand; initiation of ECMO emergently can result in more difficult cannulation. A planned procedure with echocardiography or fluoroscopy improves flows by optimizing cannula placement and reduces catheter manipulation. Choice of ventilator settings is large influenced on flows defined by the ECMO circuitry. For example, if a VA ECMO circuit fails to empty the right atrium and ventricle, the ventilator is obliged to oxygenate the non-ECMO blood. If not, shunt physiology occurs. Understanding

the heart, lung, ventilator, circuit interaction can only be addressed by dedicated CT surgery Intensivists working in tight collaboration with medical Intensivists.

Even less reported in the literature is how to come off ECMO. As the multidisciplinary team approaches family with the idea of ECMO, the idea of stopping ECMO for futility is also introduced. Families understand that ECMO may be withdrawn for intracranial hemorrhage or refractory shock. Fortunately this rarely happens. Typically Cardiac Ecmo is withdrawn by trials of ecmo wean with echocardiogram confirming improvement of and maintenance of cardiac output with low pump [12,13]. Looking at compliance and radiologic markers are also very helpful in determining wean for respiratory ECMO [14]. Our system is getting better with our increased volumes.

Our ten year experience with ECMO has shown that planning administratively, organizing the network, and bedside communication has improved our effectiveness with ECMO. A multidisciplinary approach ECMO and collaboration improves our preparedness to support these critically ill patients. ECMO is here to stay, supporting these critically ill patients as the literature defines exact roles.

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